

Note on the Spectrum of the Eclipsed Moon. By Capt. W. Noble.

Those Fellows of the Society who were present on March 9 will remember that, at the conclusion of Mr. Penrose's Paper on the "Total Lunar Eclipse of February 27," I made some oral remarks on the spectrum of the obscured Moon as viewed from my own station. Notwithstanding the vivid redness of the lunar disk as seen by the naked eye, I found, to my exceeding surprise, that its spectrum was cut off in a most remarkable manner at the least refrangible end; in fact, that, with a pretty wide slit, it did not begin very much before D, as determined by an extemporised sodium-spectrum. I learned afterwards that no such truncation was visible at Greenwich. Observing the second eclipse of the Moon this year (that of August 23) I once more turned my spectroscope on to the shadowed disk, this time to be struck by the brilliancy of the red end of the spectrum, which seemed to me to extend to little *a*, if not further. Now, however, comes the curious part of the story. In the supplementary number of the *Monthly Notices* I find that Mr. Christie and Mr. Maunder, observing at Greenwich, noticed that "the red and blue ends of the spectrum were completely cut off, whilst the orange was greatly reduced in intensity." This would surely seem to point to our own atmosphere as the immediate cause of this remarkable absorption. Forest Lodge is only some thirty-seven or thirty-eight miles, as the crow flies, from the Royal Observatory, but this is an interval which would admit of very diverse atmospheric conditions obtaining at the two stations. It may be that the recent curious and interesting discovery of what he calls the "rainband" by the Astronomer Royal for Scotland (of which his own account will be found in recent Nos. of the *Astronomical Register*) will afford at least a partial explanation of the remarkable discrepancy. I find, on reference to my own meteorological register, that rain fell at my station on February 27, when the red end of the spectrum was cut off, and that none descended there on August 23, when the spectrum extended so much further. At all events, there seems no escape from the conclusion that the cause of the variation was terrestrial. Had it had its origin outside of our atmosphere, that is in the quality of the light refracted within the Earth's shadow, no difference could possibly have been perceptible at places only thirty-seven miles apart.

*Physical Observations of Mars, made at the Royal Observatory,
Greenwich.*

(Communicated by the Astronomer Royal.)

The spectrum of *Mars* has been examined on several occasions lately with the single-prism spectroscope, in order to detect either

traces of atmospheric absorption, or any differences in the spectrum as obtained from different parts of the disk. For the former purpose the spectrum of *Mars* was compared with that of the Moon on August 23 and September 26, when their altitudes were very nearly equal, that of *Mars* being 26° and 24° on the two occasions respectively, and of the Moon 24° and 23° . Several faint diffused bands, besides the sharp Fraunhofer lines, were observed in the spectrum of *Mars* on both occasions; and some of these were also seen on September 21, when the planet was again examined, but not compared with the Moon. The following table shows the wave-lengths of these bands, expressed in tenth-metres:—

Absorption Bands in Spectrum of Mars.

Line.	Aug. 23.	Sept. 21.	Sept. 26
Band δ of the Brewster spectrum {	First edge ...	5640	5639
	Second edge ...	5661	5717
Group of lines round D {	First edge ...	5889	5887
	Second edge ...	5907	5897
Faint band. Centre reading	6019	6022	...
Band α . Centre reading	6287	6287	6298
Very faint band. Centre reading	...	...	6511
Group of lines round C {	First edge	6544	6537
	Second edge	6572	6587
Very faint band. Centre reading	...	...	6695
Very faint band B (?). Centre reading	6852	...	6895

Of these bands only the three most pronounced—viz. band α and the groups round C and D—were visible in the spectrum of the Moon. Of these α was only suspected to be present; the D group was decidedly narrower than in *Mars*, and that round C was only $\frac{2}{3}$ the breadth of the same group in *Mars*, and so much fainter that it was not seen until the pointer had been set to the proper reading for it, although, when once it had been found, it was easily recognised. The dispersive power of the spectroscope employed being small, and the red end of the spectrum much contracted, the groups of atmospheric lines round C and D would necessarily appear as an unbroken band.

On September 12, when the large dark spot, called in Proctor's Chart "Dawes Ocean," occupied the centre of the disk, the spectrum of *Mars* was examined for the detection of local differences. The dark spot gave a much fainter spectrum than the rest of the disk, the contrast being very marked in the red and yellow, and less so in the violet; it showed, however, no lines or bands other than those seen in other parts. The spectrum of the polar spot and its neighbourhood was very bright from about D to F, but showed very little red; the north limb, on the

contrary, gave a spectrum somewhat less bright in the green and yellow, but extending further into the red. The group round C seemed to be darker over "Dawes Continent" (the bright spot north of "Dawes Ocean") and less dark on the north limb. Bands *a* and B were seen, but no difference was remarked in their appearance from whatever part of the disk obtained; but, being fainter than C, a slight difference was less likely to be detected.

On September 21 and 26 the absorption bands then measured were noticed to be very slightly fainter on the limb than anywhere else. The locality where they were most distinct was variously estimated as from 5'' to 6'' from the limb on September 21, and from 3'' to 4'' on September 26. As the definition was much better on the latter occasion, the smaller estimation is more likely to be correct. The difference in intensity, except just on the limb, was exceedingly slight, but the point where the bands were estimated to be darkest was always found to be at very nearly the same distance from the limb.

The red end of the spectrum of *Mars* was much fainter on or near the limb, but the violet seemed of the same intensity from all parts of the disk, and was visible about as far as in the spectrum of the Moon.

The observations were made by Mr. Maunder.

Drawings (29 in all) have been made of the planet at every favourable opportunity during the late opposition, and some apparent changes, suggesting variations in the atmosphere of *Mars*, have been noted. It is, however, very difficult to determine how far such changes are due to the varying state of our own atmosphere. Variations were noted in the colour of the markings and in the comparative brightness of the limb, which usually presented the appearance of a bright ring, obliterating the dark markings more or less completely within about 4'' from the edge of the disk. The table shows the appearances that have been noted on various occasions, and the state of the definition corresponding.

Changes in Appearance of Mars.

1877. <i>Bright ring round limb.</i>	Aug. 30. Bright.	Sept. 12. Bright.	Sept. 19. Hardly visible; limb orange.	Sept. 21. More ap- parent, but not so bright as on Sept. 12.	Sept. 24 & 26. Not per- ceptible. marked.	Sept. 27 & 29. More marked.	Oct. 2. Very marked.	Oct. 15. Very marked.	Oct. 16. Scarcely visible; dark markings visible up to limb.	Oct. 22. Not marked.	Oct. 23. Very bright on <i>p</i> side.
<i>Dark spots.</i>	Blue gray.	Dark olive green.	Neutral.	...	...	...	Neutral.	...	...	Dusky.	Cobalt blue.
<i>Bright spots.</i>	Rose.	...	Dull orange.	Yellower or whiter than on Sept. 19.	Orange; purer and livelier than on Sept. 19.	...	Livelier orange, brightening in parts into yellow or white.	...	...	Colour not marked.	Colour very marked; pale vermilion.
<i>Definition.</i>	...	Very good.	...	Trem. and bad.	Much better on Sept. 26.	Sept. 27, poor; Sept. 29, good.	Good, and very steady.	Bad, and unsteady.	Faint from fog, and not steady.	Good.	Very good.

The following points have also been noted:—On September 12 a thick cluster of points, darker than the bright spot but much brighter than the adjoining dark spot, formed a fringe on the border between Dawes Continent and Dawes Ocean (Proctor's Chart) or Hour-glass Sea, a boundary which, when seen under nearly the same aspect on September 7, had appeared remarkably sharp and distinct. On October 15 the long narrow bright strip stretching into the centre of the disk was very ill-defined at both ends, where it was both fainter and whiter than the rest. A very bright white spot was noted on October 22 on the *s.p.* limb in a position corresponding to the *p.* end of this strip. The large bright patch towards the *s.f.* limb (Lockyer Land of Proctor's Chart) seemed to move round a little more rapidly than the other markings, as if elevated above them. In the course of a couple of hours it seemed to have encroached on the dark strip on its *n.p.* side, making it appear narrower. The bright patch (Lockyer Land) was noted as being very bright and white on October 22. Dawes' so-called "Snow Island" was seen on October 2 as a white spot in De la Rue Ocean.

On August 30 the polar spot appeared to be serrated, showing three indentations round the edge when the definition was at its best. As far as could be judged, this was not an effect of tremor in the air. On September 29 the polar spot was noted as being irregular in shape, and on October 22 the dark ring round it appeared to be much darker on the *f.* side.

The above observations would appear to indicate the presence of occasional clouds in the atmosphere of *Mars*, but they require confirmation.

The outer satellite of *Mars* was seen on five nights and the inner on one, viz. September 28. Only one micrometer measure of the outer satellite was obtained, as follows:—

	G.M.T.			Pos. Angle.	Dist. (from 1st limb).
1877.	h	m	s	°	'
Sept. 29	8	54	56	248	31
					67.5

Estimations were made on the other nights.

The observations were made by Mr. Christie and Mr. Maunder.

Royal Observatory, Greenwich,
1877, November 9.

Observations of Mars at Madeira, August and September 1877. By N. E. Green, Esq.

Madeira was chosen as a place of observation for its southern position, its reputation for clear skies during the months of August and September, and because the heat at that season is less than at other places on the same parallel of latitude.